resistant tuberculosis, partly associated with the spread of the human immunodeficiency virus, has led to concern that health care workers in high-risk settings are not adequately protected from work-related exposure to tuberculosis.

Since 1988, several hundred health care workers are estimated to have acquired tuberculosis from workplace exposure. Of particular concern is that at least 16 health care workers have been infected with drug-resistant tuberculosis in outbreaks at seven hospitals and one prison. Control measures to reduce the risk of work-acquired tuberculosis include patient isolation, negative-pressure rooms, medical surveillance of health care workers with possible exposure, and a respiratory protection program. Without such measures, the extensive spread of tuberculosis, including the drug-resistant form, among health care workers is a real possibility.

A number of studies have shown that surgical masks are ineffective as a precaution against airborne infection. These masks are designed to protect patients, not health care workers. Surgical masks cannot effectively filter the 1- to 5-μm droplet nuclei that form when larger tuberculosis-containing droplets evaporate, nor can they provide an effective face seal. Only properly fitted respirators with high-efficiency filters comply with guidelines from the National Institute of Occupational Safety and Health, OSHA, and the Centers for Disease Control and Prevention (CDC) for protection from tuberculosis. Placing surgical masks on patients is recommended only as a temporary measure when patients are outside isolation rooms. Although the volume of exhaled aerosols is reduced somewhat when patients wear masks, outward leakage will still occur.

The Occupational Safety and Health Administration announced that in 1994 it would issue citations to employers who lacked a tuberculosis control program for health care workers with exposure to patients with suspected or confirmed tuberculosis or who performed or assisted with a "high hazard procedure," including nebulizer treatments, bronchoscopy, sputum induction, suctioning, and autopsies.

Draft guidelines issued by the CDC in October 1993 called for the use of respirators that would provide filtration of at least 95% of particles 1 μm in size (about the size of a droplet containing bacteria) and that could be fitted to obtain a face seal of no more than 10% leakage. In other words, respirators would have to have a protection factor of 10 or greater. This exceeds the protection available from dust mask-type respirators. The Occupational Safety and Health Administration currently requires high-efficiency particulate aerosol (HEPA) filtered respirators for protection against tuberculosis. Most HEPA respirators are twin-cartridge clastomeric face-piece industrial models, although a few disposable HEPA respirators are now available. A powered air-purifying respirator may be used to provide protection without the need for fit testing or when a health care worker has facial hair that would interfere with seal.

Engineering controls are the preferred means of hazard control. Negative-pressure isolation rooms and treatment booths, HEPA-filtered ventilation systems, and, possibly, germicidal irradiation are appropriate engineering safeguards for tuberculosis control. Administrative controls, such as reducing the number of persons who enter isolation rooms, may be useful in reducing the number of possibly exposed workers who require respiratory protection. The Occupational Safety and Health Administration also recommends medical surveillance of hospital employees by means of tuberculosis skin testing on employment and at least annually thereafter. Health care employers also must become familiar with the administration and technology of respiratory protection. Written respiratory protection programs, fit testing, respirator selection protocols, medical determinations, and training are required whenever respirators are used. Opposition from the hospital community and health care workers themselves must be overcome. A 1992 attempt by the New York OSHA regional office to require a respiratory protection program in hospitals met with deep-seated resistance and a barrage of complaints. How successful hospitals will be in implementing respiratory protection programs for large numbers of workers remains to be seen.

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Hepatitis B Immunization

ABOUT 300,000 PERSONS in the United States become infected with the hepatitis B virus (HBV), and about 3,000 persons die each year of fulminant hepatitis, cirrhosis, and hepatocellular carcinoma related to HBV infection.

Plasma-derived hepatitis B vaccine (Heptavax-B) has been licensed in the United States since 1981 and recombinant vaccines (Engerix B, Recombivax HB) since 1986. Hepatitis B vaccines are standardized for potency, and thimerosal is used as a preservative. Both plasma vaccine (which is sterilized in three steps, all of which inactivate the human immunodeficiency virus and all classes of viruses) and recombinant vaccines are safe and immunogenic (greater than 90% protective antibody response). Plasma-derived vaccine is indicated only for hemodialysis patients and other immunocompromised hosts and persons with yeast allergy. The recommended series in three doses is administered intramuscularly in the deltoid muscle (adults and children) or anterolateral thigh (infants and neonates) at zero, one, and six months. Poor immune responses to the vaccine in adults have been documented when administered in the buttock.

Postvaccination testing and revaccination are not rou-

tinely recommended, but a knowledge of the antibody status may be helpful for health care workers at risk for injuries from sharp instruments. Postvaccination testing should be done between one and six months after finishing the series. Despite observed drops in antibody levels over time, data to date suggest vaccinees remain protected against hepatitis B disease. Whether revaccination is necessary after an extended period awaits further longitudinal data. The need for booster doses in health care workers after exposure and in hemodialysis patients should be based on antibody testing.

Universal infant immunization with hepatitis B vaccine was recommended in 1991 by the Immunization Practices Advisory Committee of the US Public Health Service and in 1992 by the American Academy of Pediatrics and American Academy of Family Physicians. Universal infant immunization is a component of an overall strategy by the US Public Health Service to eliminate hepatitis B transmission, which includes screening all pregnant women and vaccinating adolescents and adults in high-risk groups.

Universal infant immunization has been shown to be cost-effective and cheaper than well-accepted interventions such as smoking cessation and pneumococcal vaccine. Although the risk for hepatitis B for children in uninfected households does not rise until adolescence, routine childhood immunization offers the advantage of an established vaccination delivery system and somewhat cheaper vaccine costs. Targeting high-risk adults for hepatitis B vaccination remains a priority, although about a third of adults with acute hepatitis B have no identified risk factor.

Seroprevalence studies indicate that health care workers, depending on the frequency of blood contact, are 6 to 60 times more likely to be infected with HBV than persons in the general population. The Occupational Safety and Health Administration issued new regulations in 1992 requiring that free hepatitis B immunization be offered to health care workers with possible contact with blood or blood-contaminated body fluids. Each facility should designate a responsible person to ensure that information and training on the prevention of bloodborne pathogens in the workplace, including the indications for hepatitis B vaccine, are provided annually with appropriate documentation to workers at risk.

Other groups at high risk for HBV infection include clients and staff of institutions for the developmentally disabled, hemodialysis patients, sexually active homosexual men, users of illicit injectable drugs, persons receiving clotting factor concentrates, household and sexual contacts of HBV carriers, long-term inmates of correctional facilities, and sexually active heterosexual persons.

Hepatitis B infection is endemic among Alaska Natives, Pacific Islanders, and in many countries of Asia and Africa. Long-term international travelers to these areas are also candidates for hepatitis B vaccination.

For prophylaxis after exposure—such as in infants born to women with the hepatitis B surface antigen (HBsAg) and persons with needle-stick exposure to HBsAg-positive blood—the administration of both hepatitis B immune globulin and vaccine is indicated. Package inserts should be consulted for variations in dosage and immunization schedules for different licensed products for prophylaxis before and after exposure.

The number of cases of hepatitis B has declined in the United States since 1985, but the incidence rate of acute hepatitis B is only now dropping below the rates of the late 1970s. Sustained efforts at a wider application of hepatitis B vaccine are needed.

Simplifying the immunization schedule and an oral vaccine using recombinant technology would be welcome advances.

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